

# Pathways Study

## Evaluation and Impact Analysis

Todd Schatzki  
Principal

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# Agenda

- Overview of Assignment and Approach
- Model Structure and Mechanics
- Inputs, Assumptions, and Scenarios Evaluated

# Overview of Assignment and Approach

# Assignment

- Analysis Group (AG) has been asked to evaluate proposed alternative **approaches** to a more decarbonized future grid and compare them to continuation of the current rules (“Status Quo”). Thus, we will evaluate three approaches, or cases:
  - Status Quo
  - Forward Clean Energy Market (FCEM) / Integrated Clean Capacity Market (ICCM)
  - Net Carbon Pricing
- Our work will include **quantitative and qualitative analysis** of each approach with the goal of identifying important differences between them
  - We will focus on factors that are most relevant to differentiating between these approaches, such as environmental and economic outcomes, and how each approach incents desired resource mix changes
  - Quantitative analysis will aim to capture key differences in environmental and economic outcomes, but, in practice, will not capture all differences
  - Qualitative analysis will identify and assess differences between approaches that are not captured by the quantitative analysis

# Assignment

- The **quantitative modeling** of each approach based on cases designed to illustrate key differences between each approach:
  - Compare approaches under common “**central**” assumptions and also consider alternative scenarios reflecting different common assumptions and particular design choices
  - Illustrate the mechanisms by which each approach incents changes in investment or behavior that result in different market outcomes, drawing on examples from model runs
  - Quantitative work will focus on outcomes most relevant to understanding the choice regulatory approach to incenting desired resource mix changes – as a result, certain factors important to future grid outcomes, such as reliability outcomes, will be less of a focus
  
- Our work is intended to inform stakeholders about the proposed approaches

# Quantitative Analysis Approach

- Evaluate outcomes of each approach starting with a central case
  - Each approach will be analyzed assuming the same market conditions and emission targets
  - Intention is to analyze using a common set of assumptions so that differences in outcomes across scenarios reflect differences in approaches, not other factors
- Evaluate market outcomes under additional scenarios
  - Some scenarios will test sensitivity to different assumptions about market conditions, policy targets and other factors common to all approaches
  - Other scenarios will test the sensitivity of outcomes to design decisions for particular approaches
- Modeling inputs, assumptions, and scenarios will be informed by discussion with and feedback from stakeholders
  - Where feasible and sensible, we will align assumptions with the Future Grid Reliability Study (FGRS)

# Overview of Schedule and Process

- Study will proceed in stages to:
  - Align AG, ISO and stakeholders on study objectives
  - Gather stakeholder input on design of approaches, input assumptions and desired scenarios
  - Provide preliminary results to obtain stakeholder feedback
  - Develop final study findings, including final report
- Process will proceed according to the following proposed schedule:
  - **May-June, 2021**                      Discuss approach designs, model inputs, and scenarios
  - **July-August, 2021**                 Simulation modeling (potential for additional stakeholder discussion of inputs)
  - **October, 2021**                      Preliminary results
  - **November, 2021**                  Detailed central case results
  - **December, 2021**                 Preliminary scenario results
  - **February, 2021**                    Report delivered

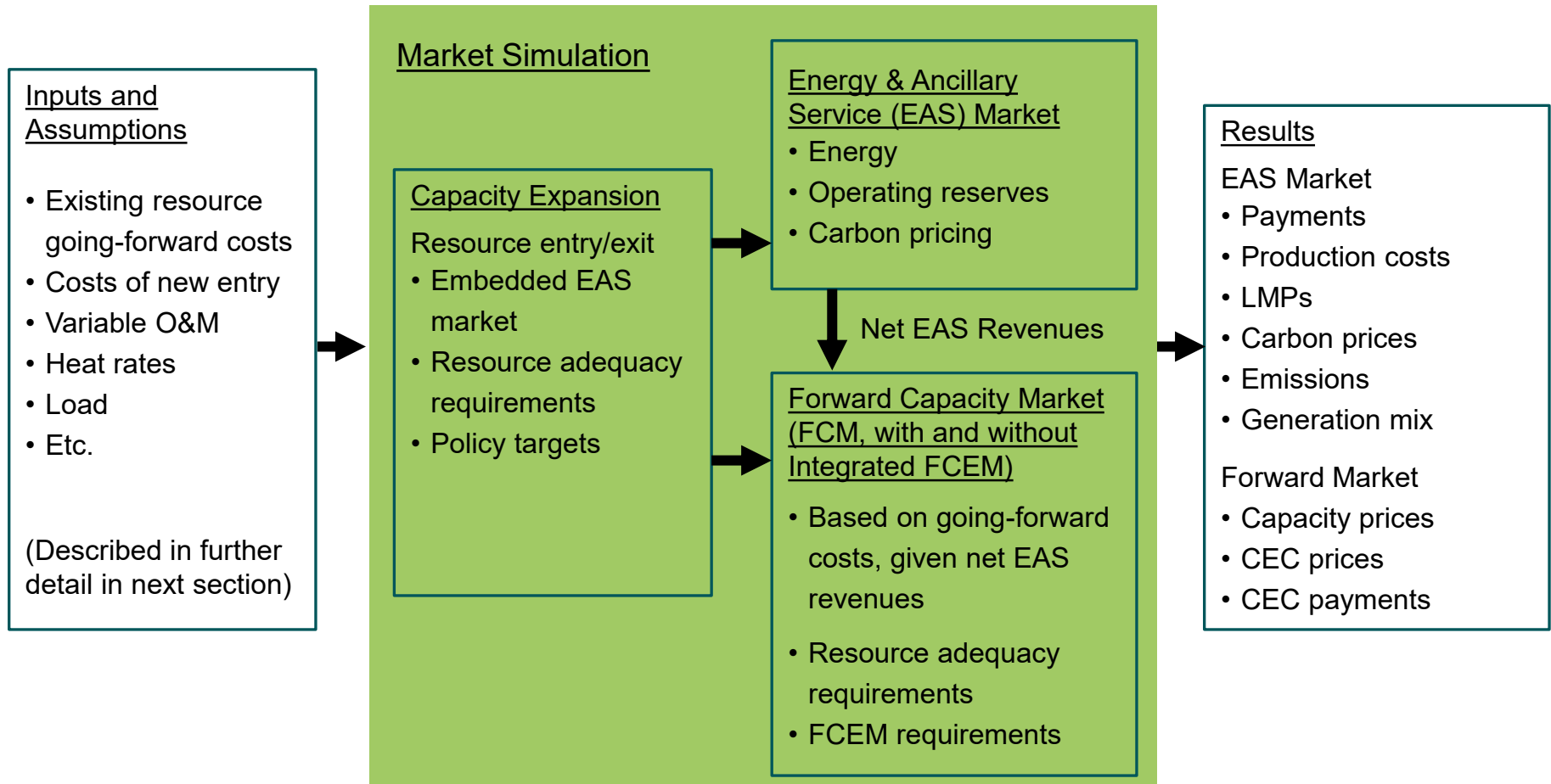
# Model Structure and Mechanics



## Overview of Modeling Approach: Model Components

- Analysis will use a multi-module model to simulate the New England electricity markets:
  - Energy markets, including proposed net carbon pricing
  - Capacity markets
  - Proposed clean energy market frameworks
- Models will reflect current market structures and rules, and not include potential modifications that may occur in the future
  - Application of MOPR will be determined
- Model follows two steps:
  1. Determine the future resource mix using a “capacity expansion” model
  2. Analyze outcomes in energy market and capacity market, reflecting approach taken to meeting decarbonization target (status quo, FCEM or net carbon pricing)

# Overview of Modeling Approach: Model Components



## Common Inputs and Assumptions

- Common set of central case assumptions across all approaches
  - Regional carbon emission target
  - Hourly load shapes, reflecting assumed electrification of transportation and heating
  - Existing generation portfolio (and their operating parameters and costs)
  - Renewable generation profiles (reflecting weather patterns)
  - Fuel and non-carbon emissions prices
  - Existing state policies, including RPS
- Different approaches to achieve regional carbon emission target beyond central case state policies:
  - Status quo – Incremental state policies to meet target, with long-term contracts
  - FCEM / ICCM – Procurement of Clean Energy Certificates (CEC) to meet regional target
  - Net Carbon Pricing – Set carbon price to meet regional target
- Market footprint will include ISO-NE and NYISO, with supply curve for HQ

## Proposed Study Outcomes

- This study will focus on differences in outcomes across approaches to give insight into how outcomes may differ under each approach
- Potential quantitative outcomes include:
  - Customer payments
  - Total production costs
  - Wholesale energy and reserve prices (LMPs)
  - Capacity prices
  - Environmental prices (carbon, CEC)
  - Emissions
  - Resource mix, by technology type (MW, MWh)
- Qualitative analysis
  - Quantitative analysis will capture some but not all differences in approaches, while qualitative analysis will aim to identify and evaluate other consequential differences in outcomes across approaches

# Inputs, Assumptions, and Scenarios Analyzed

## Approach to Inputs and Assumptions

- The model requires many inputs and assumptions, some involving substantial detail
  - Where possible and sensible, we will align assumptions with the FGRS
  - Other assumptions will be developed with the aim of capturing future market and system conditions to provide the most suitable basis for comparing approaches
- Central case inputs will be developed first, and scenario analysis will be performed based on changes to the central case assumptions
  - Scenario analysis will generally reflect changes to either approach design or market conditions
- The following slides provides an overview of key assumptions and inputs, and provide preliminary thinking on assumptions in certain areas
- We welcome stakeholder feedback on inputs and assumptions, and final inputs and assumptions will reflect feedback received from stakeholders

# Modeling Inputs and Assumptions

- Study Parameters
  - Year(s) studied
  - Regional carbon target (applicable to each approach)
- Electricity Markets
  - Current resource mix, known additions/retirements
  - Fuel prices
  - RGGI and non-carbon emissions pricing
  - Import/export assumptions
  - Load shapes (hourly)
    - Electrification (transportation, home heating) assumptions
    - Energy efficiency assumptions
  - Renewable hourly resource profiles (e.g., hydro, onshore wind, offshore wind, solar)
  - Storage resource specifications
- Capacity Markets
  - Going forward costs (fixed operating costs for existing resources)
  - Technology-specific cost of new entry (CONE) (amortized capital and fixed operating costs)
  - MOPR (i.e., will MOPR be applied or not applied)

# Approach Inputs and Assumptions

## ■ State Policies

- Existing policies to be assumed across cases, such as RPS

## ■ Status Quo

- Incremental policies (e.g., incremental RPS) needed to meet assumed regional carbon target and their specific implications for technology mix and location
- Current and future long-term contracts (implications for costs)

## ■ Net Carbon Pricing

- Carbon price (to achieve regional carbon target)
- Leakage rules

## ■ FCEM / ICCM

- Design:
  - Integration of FCEM into FCM
  - Eligibility of resources for CECs
  - Static CECs (potential for dynamic scenario)
- Inputs:
  - State-level demand for CECs (to achieve the regional carbon target)
  - Resource-level CEC offer quantity
- Allocation of costs and settlement:
  - Non-compliance penalty rates
  - Banking of CECs across years



## Modeling Year(s) Studied

- Preliminary thinking to use target year of 2040
  - Consistent with FGRS
  - Capacity expansion model will provide resource mix for intermediate years
  - Potential to include full results for other years or certain policies/scenarios, particularly if we determine that findings differ for intermediate years
- Analysis will assume a ‘weather normal’ year
  - Preliminary thinking is to use 2019, modified to reflect future changes

# State Policies

- Many current states policies:
  - RPS - Current RPS targets reflect both legislation and executive orders
  - Clean Energy Standard (CES) – In effect, expands to include other non-emitting sources
  - Procurements – zero carbon resources (CT), off-shore wind (MA, RI), etc.
  - Others – Clean Peak Standard (MA), cap and net metering (behind the meter changes in load), trade (MA), solar targets and policies (e.g., rebates – CT, SMART – MA)
- Policies vary in statutory mandate:
  - Some policies explicitly specified in statute
  - Some policies implemented to achieve statutory target
  - Some policies implemented via executive order

# Current State Policies

## Aggregate, Regional Impact of Various State Policies

- Existing policies vary across states in terms of quantity of targeted clean/renewable energy (and eligible technologies)

State	2040 Requirement Quantity (% of Load)	
	RPS Only	RPS + CES + Other
Connecticut	48%	100%
Maine	80%	80%
Massachusetts	57%	74%
New Hampshire	25%	25%
Rhode Island	39%	100%
Vermont	75%	75%
Total (load weighted)	54%	77%

**Note:** Estimates by AG based on review of state legislative mandates. “CES + Other” includes Massachusetts Clean Energy Standard, Massachusetts Alternative Energy Portfolio Standard, and Executive Orders in both Connecticut and Rhode Island. Load weighting based on ISO-NE’s 2029 load forecast, net of behind the meter solar and energy efficiency.

# State Policies

- State policies assumed with each approach need to reflect a reasonable mix of existing policies, with alternative approaches being studied – i.e., status quo, FCEM / ICCM, net carbon pricing – achieving incremental carbon reductions to achieve regional carbon target
  - If central case policies achieve too many reductions, analysis of approaches will not yield useful information for assessment
- Potential options
  1. Include only outcomes of existing procurements and planned procurement (i.e., no RPS)
  2. Include a scaled down version of current RPS
  3. Current RPS (e.g., as represented on prior slide)
- Preliminary observations
  - #1 (existing procurements) provides the opportunity to most clearly differentiate between the three approaches
  - #2 (scaled-down RPS) may balance desire to account for existing state policies and allow the study to provide useful information to evaluate the approaches
  - #3 (current RPS) may offer too little incremental reductions to meaningfully evaluate the approaches
- We look forward to input from stakeholders on a sensible mix of assumptions

# Potential Scenarios

- Across approaches:
  - Alternative regional carbon target
  - Alternative levelized costs of new entry for renewable resources (given uncertainty in cost trajectory)
  - Alternative load forecasts (e.g., different levels of electrification of heating, transportation)
  - Alternative natural gas price projection
  - Remove existing (central case) state policies
  - Alternative MOPR assumption (removal/inclusion depending on central case assumption)
- Status Quo
  - Alternative costs of long-term renewable contract procurement
- FCEM / ICCM
  - “Dynamic” pricing (may be studied in an abridged fashion)
  - Alternative penalty rate
- Net Carbon Pricing
  - Leakage rules
- We look forward to input from stakeholders on a sensible mix of scenarios
  - Timely input will increase likelihood that model is capable of evaluating or can reasonably evaluate the desired scenario

## Next Steps

- **May**
  - Review feedback from stakeholders
  - Provide preliminary proposal for assumptions and inputs
- **June**
  - Review any additional feedback from stakeholders
  - Present finalized assumptions and inputs

## Contact

Todd Schatzki

Principal

617-425-8250

Todd.Schatzki@analysisgroup.com